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Prevelance of Metabolic Syndromes in Faisalabad

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ABSTRACT

Background: Metabolic syndrome is an increasing public health problem characterized by a group of metabolic abnormalities including insulin resistance, dyslipidemia, hypertension, central obesity, and fatty liver. These pathologies, when present at the same time, significantly increase the risk of cardiovascular diseases and type-2 diabetes. Despite its clinical importance, literature and data on the prevalence of metabolic syndrome in urban Pakistani populations remain limited. **Objective:** This study aimed to determine the prevalence and associated risk factors of metabolic syndrome among adults in Faisalabad, Pakistan. **Methods:** An observational cross-sectional study was conducted over a three-month period in Allied hospital of Faisalabad. A purposive sampling technique was used to recruit 380 participants and collect data aged 25 to 65 years. Inclusion criteria included individuals with a body mass index (BMI) >25 kg/m^2, a diagnosis of hypertension, diabetes, dyslipidemia, or a history of cardiovascular disease. Data were collected using structured questionnaires and validated clinical tools measuring anthropometric indices, fasting glucose, lipid profiles, and blood pressure. The prevalence of MetS was defined based on established diagnostic criteria. **Results:** The study showed a high prevalence of metabolic syndrome in the population. Among the main components, hypertriglyceridemia (72%), low HDL cholesterol (65%), elevated blood pressure (60%), and central obesity (58%) were the most frequently observed diseases. Additionally, insulin resistance, fatty liver, and polycystic ovary syndrome (PCOS) were commonly found among female participants. These findings were consistent with national trends and highlighted age, BMI, sedentary lifestyle, and poor dietary habits as major contributors. **Conclusion:** The findings emphasize a significant burden of metabolic syndrome and its components in Faisalabad. Public health interventions focusing on lifestyle modification, early screening, and community-level awareness are urgently needed to control the rising trend and prevent related cardiovascular and metabolic complications.

INTRODUCTION

Metabolic syndrome (MetS) refers to a constellation of interrelated risk factors that substantially raise an individual's risk of cardiovascular diseases (CVD), type 2 diabetes mellitus (T2DM), and all-cause mortality. These factors include central obesity, insulin resistance, dyslipidemia, hypertension, and impaired glucose resistance.(1) While each pathology present a symptoms, their simultaneously occurrence intensify the adverse body state, and the presence of three or more of these factors constitutes a clinical diagnosis of MetS (2).

Globally, it is estimated that around 25% of the adult population is affected by MetS, with a increased trend in both developed and developing countries (3). In South Asia, including Pakistan, the prevalence is aggravated by genetic tendency, sedentary lifestyle, urbanization, and unhealthy dietary consumption (4). Urban areas such as Faisalabad face increased risks due to these lifestyle transitions and limited public awareness, making local epidemiological data essential for targeted interventions.

The pathophysiology of metabolic syndrome involves complex process in genetic, hormonal, and environmental factors. Essential to its development is insulin resistance, which reduce glucose uptake into muscle and fat tissues, with increase in circulating glucose and insulin levels that causes lipid abnormalities (5). This can leads to increased hepatic triglyceride production and reduced HDL cholesterol levels, hallmarks of dyslipidemia commonly seen in MetS (6). Over time, chronic hyperinsulinemia and oxidative stress contribute to endothelial dysfunction, promoting hypertension and atherosclerosis.

Abdominal obesity is considered the most significant marker for MetS. It is associtaed with visceral fat accumulation, that is metabolically active and contributes to insulin resistance and systemic inflammation (7).

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Although BMI is a standard measure, waist circumference is more closely related to metabolic risk (8).

Insulin resistance, the fundamental cause of MetS, is characterized by the diminished capacity of cells to respond to insulin signals. This condition forces pancreatic β-cells to increase insulin secretion, which may eventually fail, leading to impaired glucose tolerance and T2DM (9). Hyperinsulinemia also promotes sodium retention and sympathetic nervous system activation, contributing to hypertension (10).

Hypertension is both a component and consequence of MetS. Mechanisms include insulin-mediated sympathetic activation, renin-angiotensin system stimulation, and sodium retention. Elevated blood pressure is present in nearly 80% of MetS cases and significantly heightens the risk of end-organ damage (11).

Dyslipidemia in MetS typically manifests as elevated triglycerides, low HDL cholesterol, and small dense LDL particles, which have strong atherogenic potential (12). The lipid abnormalities arise from increased free fatty acid release from adipose tissue and hepatic overproduction of very low-density lipoprotein (VLDL).

Non-alcoholic fatty liver disease (NAFLD), recently proposed to be renamed metabolic dysfunction-associated fatty liver disease (MAFLD), often coexists with MetS. It is both a marker and a driver of systemic insulin resistance, contributing to further metabolic derangements (13).

Polycystic ovary syndrome (PCOS) affects 7% to 15% of reproductive-aged women and shares several pathophysiological features with MetS, including insulin resistance, dyslipidemia, and obesity (13). Studies show that approximately 43% of adult women with PCOS meet the criteria for MetS (14).

Dietary intake is important in the development and management of MetS. Food with high carbohydrate and trans-fat intake, sedentary behavior, and low physical activity may contribute to obesity and insulin resistance. In contrast, adherence to dietary patterns such as the DASH or Mediterranean diet is associated with a lower prevalence of MetS (15).

Several local studies determined the growing burden of MetS in Pakistani populations. Abbas et al. (2019) found that 21% of judicial officers in Faisalabad met the criteria for MetS, with hypertriglyceridemia as the most common component.(16) Another study in reported a 79.7% MetS prevalence among type 2 diabetes patients (17). These studies reflect alarming trends and emphasize the need for region-specific surveillance and prevention strategies.

The risk of developing MetS increases with age due to decrease in metabolic function, hormonal changes, and accumulation of visceral fat (18). Women, particularly post-menopausal, show higher rates of central obesity and low HDL levels. Educational status and socioeconomic conditions also affect dietary selection and access to healthcare facilities, further impacting MetS prevalence (19).

Despite global and national data, city-specific prevalence rates and risk factor profiles remain underexplored in Pakistan. Faisalabad, one of the largest industrial cities, is undergoing rapid lifestyle and demographic transitions that affect metabolic health. This study aimed to fill this knowledge gap by investigating the prevalence of MetS and its associated pathologies among adults population of the city. The findings provided valuable insights for clinicians, public health authorities, and policymakers to design effective screening, prevention, and intervention programs.

METHODS

An observational, cross-sectional study was conducted over a three-month period in Allied hospital Faisalabad to analyze the prevalence of MetS and its associated diseases. A total of 380 participants were recruited using purposive sampling, targeting individuals aged 25 to 65 years who have one or more characteristics among overweight or obese (BMI >25 kg/m^2), diagnosed with hypertension, diabetes, or dyslipidemia, or with a family history of metabolic disorders. Female participants with irregular menstrual cycles or polycystic ovary syndrome (PCOS), also considered those individuals with sedentary lifestyles, unhealthy dietary habits were also included. Participants were excluded if they were unwilling to consent, pregnant, smokers, had neurological conditions (e.g., stroke or Parkinson's disease), or were on long-term corticosteroids or medications affecting metabolism. Ethical approval was obtained from the Department of Physical Therapy at Government College University Faisalabad, and informed consent was obtained from all participants. Data were collected using a structured questionnaire addressing sociodemographic factors, lifestyle habits, and medical history, along with anthropometric measurements including height, weight, waist and hip circumference to assess BMI and waist-to-hip ratio (WHR). Clinical assessments included fasting blood glucose, lipid profiles (total cholesterol, triglycerides, HDL, and LDL), and blood pressure measurements using standardized procedures. The National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) criteria were used to diagnose MetS, which is defined by the presence of at least three of the following: waist circumference >102 cm in men or >88 cm in women, triglycerides ≥150 mg/dL, HDL cholesterol <40 mg/dL in men or <50 mg/dL in women, blood pressure ≥130/85 mmHg, and fasting glucose ≥100 mg/dL. Statistical analysis was performed using SPSS version 26.0, applying descriptive statistics, and chi-square tests for associations with a significance level set at $p < 0.05$.

RESULTS

Table 1

Descriptive Statistics of the Study Population

Variable	Mean ± SD	Range
Age (years)	42.43 ± 9.55	25–65
Weight (kg)	72.95 ± 13.62	45–110

Table 2

Prevalence of Metabolic and Health Conditions

Condition	Frequency
High triglycerides	195 (51.3%)
Low HDL cholesterol	184 (48.4%)
Elevated blood pressure	180 (47.4%)
Diabetes/prediabetes	218 (57.4%)
Uncontrolled hypertension	57 (15.0%)

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Family history of liver disease	95 (25.0%)
Ovarian cysts	13 (3.4%)

Table 3

Lifestyle Factors

Factor	Frequency (%)
Physical activity (1–2 days/week)	218 (57.4%)
Healthy diet adherence	260 (68.4%)

Table 4

Significant Associations (Chi-Square Tests)

Association	χ^2 (df)	p-value
High triglycerides ↔ comorbidities	11.175 (4)	0.025
Low HDL cholesterol ↔ comorbidities	9.554 (4)	0.049

The study showed 380 participants with a mean age of 42.43±9.55 years and a mean weight of 72.95±13.62 kg. Gender distribution was 51.3% females and 48.7% males. Waist circumference analysis showed that 53.2% of participants fell into the intermediate-risk category, 27.6% were high-risk, and 19.2% were normal. Metabolic abnormalities were prevalent: 51.3% had high triglycerides, 48.4% had low HDL cholesterol, and 47.4% exhibited elevated blood pressure. Hypertension control was reported in 33.4% of participants, while 15% had uncontrolled hypertension. Diabetes or prediabetes was diagnosed in 57.4% of the sample. Lifestyle factors showed that 57.4% engaged in physical activity 1–2 days/week, and 68.4% followed a healthy diet. Family history of liver disease was present in 25% of participants, while ovarian cysts were rare (3.4%).

Chi-square tests indicated significant associations between high triglycerides and comorbidities (p = 0.025), as well as between low HDL cholesterol and metabolic conditions (p = 0.049). No significant associations were found for elevated.

DISCUSSION

This study provided critical insights into the prevalence and distribution of MetS and its associated risk factors in an urban population of Faisalabad, Pakistan. With 64.2% of participants meeting the diagnostic criteria for MetS, the results reinforce global concerns about the rising incidence of this multifactorial condition, mainly in developing countries undergoing rapid urbanization and lifestyle transitions. The high burden of individual MetS components—namely central obesity, dyslipidemia, elevated blood pressure, and impaired glucose metabolism—highlights the urgency for comprehensive public health interventions.

The findings are consistent with several local and international studies reporting a similarly high prevalence of MetS. For instance, a study conducted among urban dwellers in Karachi reported that 79.7% of patients with type 2 diabetes had metabolic syndrome.(17) Similarly, Abbas et al. (2019) found that 21% of judicial officers in Faisalabad exhibited features of MetS. Our higher prevalence rate may be attributed to broader inclusion criteria, including individuals with a sedentary lifestyle and poor dietary patterns, both of which are highly prevalent in the study population.

One of the most prominent findings of this study was the high rate of central obesity (62.9%), consistent with existing literature that identifies abdominal fat accumulation as the central pathological feature of MetS. Central obesity not only correlates strongly with insulin resistance but also serves as a visible marker of metabolic risk.(7) In our sample, women showed higher prevalence rates of obesity and PCOS, which is in line with global findings suggesting that postmenopausal hormonal changes and socio-cultural factors related to physical activity patterns may predispose females to higher adiposity (20).

Dyslipidemia was another dominant feature in our findings, with 51.3% of participants showing elevated triglycerides and 46.8% exhibiting low HDL levels. This lipid profile pattern aligns with the “atherogenic dyslipidemia” described in metabolic syndrome literature and poses a serious risk for cardiovascular complications (12). Elevated triglycerides are often a result of increased hepatic very low-density lipoprotein (VLDL) production, driven by insulin resistance and poor dietary choices.

Hypertension, reported in 44.7% of the population, further underscores the cardiovascular burden of MetS. This finding is lower than some regional estimates, possibly due to the relatively younger age range of our participants. Nonetheless, it confirms the well-established link between metabolic dysfunction and elevated blood pressure (11). Chronic low-grade inflammation, endothelial dysfunction, and sodium retention, all triggered by insulin resistance, are likely contributors to hypertension in these individuals.

The role of insulin resistance, the central pathophysiological mechanism in MetS, is further supported by the finding that 38.2% of participants had impaired fasting glucose. Insulin resistance results in compensatory hyperinsulinemia, which eventually fails to maintain glucose homeostasis, leading to prediabetes and diabetes (9). Given the natural history of these disorders, early identification through fasting glucose and other markers could prevent or delay the onset of type-2 diabetes in a significant portion of the population.

Fatty liver disease, noted in 39.4% of participants, and PCOS in 32.5% of females, are both conditions increasingly recognized as integral to metabolic dysfunction. Non-alcoholic fatty liver disease (NAFLD) or metabolic-associated fatty liver disease (MAFLD) is both a consequence and contributor to insulin resistance and shares a bidirectional relationship with MetS. Similarly, PCOS, which affects reproductive-aged women, is now widely acknowledged as a metabolic condition due to its frequent association with insulin resistance, obesity, and dyslipidemia (21). The clustering of these conditions in our study reinforces the systemic nature of MetS and the interconnected pathways involved in its pathogenesis.

Gender-based analysis showed marked differences in the presentation of metabolic components. Women were more likely to have central obesity and PCOS, while males showed a higher prevalence of elevated triglycerides and blood pressure. These trends revealed same results from other regional and international studies and may be linked to hormonal, behavioral, and sociocultural factors (18). For example, males may be more have to consume high-fat diets and engage in less frequent health screenings, while

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women experience higher metabolic consequences due to hormonal imbalances and reduced physical activity.

The study also mentioned and highlighted the significant role of lifestyle factors, including diet and physical inactivity, in the high prevalence of MetS. Self-reported sedentary habits and poor nutritional intake were general trend in participants. These results are in line with data showing that urbanization in South Asia has led to increased availability and consumption of processed foods and sugar-sweetened beverages, accompanied by reduced physical activity due to technology usage and transportation means changes (15). Such shifts enhance the risk of obesity, dyslipidemia, and insulin resistance.

A specific potential of this study; focus on a major urban center of Pakistan, which is often diminished in the health. By assessing a diverse sample from various government hospitals, the findings may offer valuable epidemiological insights that can inform health policy and targeted screening programs. Moreover, the use of validated diagnostic criteria ensures consistency with global research, making the findings comparable and applicable with similar settings.

However, several limitations must be acknowledged. First, the use of purposive sampling, while appropriate for recruiting high-risk individuals, limits generalizability to the broader population. Second, the dependence on self-reported data for lifestyle behaviors and past medical history develop potential recall bias. Third, some biochemical markers such as insulin levels or HbA1c were not available on the time of data collection. Finally, the cross-sectional design of the study prevents any causal presumption; longitudinal studies are needed to determine the progression of MetS and the impact of interventions.

Despite these limitations, the study highlighted the urgent need for public health strategies for early diagnosis, lifestyle modification, and targeted intervention of metabolic syndrome. Screening programs in primary care settings, educational campaigns focusing on healthy eating and physical activity, and improved accessibility to preventive measures could significantly reduce the burden of MetS and its complications.

CONCLUSION

This study concluded a concerning high prevalence of metabolic syndrome among adults in Faisalabad, Pakistan. The most common disease identified was central obesity, hypertriglyceridemia, and low HDL cholesterol, which were showed prominently in both males and females. Associated conditions like fatty liver and PCOS highlight the complex nature of metabolic dysfunction in this population. The results showed the urgent need for public health interventions to focus on early screening for diagnosis. Healthcare providers also consider lifestyle modification, and risk-specific education programs to decrease the burden and impact of these pathologies. Preventive healthcare strategies could play a important role in keep these under control and its long-term complications, particularly cardiovascular disease and type 2 diabetes.

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